Electron-induced excitation and dissociation dynamics of NCCN

P Nag[1] *, M Polášek[1] and J Fedor[1]

[1]J. Heyrovský Institute of Physical Chemistry, Czech Academy of Sciences, Prague 18223, Czech Republic

Synopsis Low-energy electron collision induced vibrational excitation and dissociation of cyanogen, NCCN, has been experimentally studied. The absolute dissociative electron attachment (DEA) cross-section, kinetic energy and angular distribution of the CN^- ions measured using a recently modified velocity map imaging spectrometer are reported here. Surprising effects related to the symmetry of the involved resonances are revealed by the combination of the two spectroscopies.

We report experimental data on the low energy electron collision with cyanogen, NCCN. The complete vibrational excitation and dissociation dynamics of NCCN has been probed between 0-10 eV incident electron energy range. Only a few reports [1-2] on electron collision studies with NCCN molecule is available in literature.

In low-energy electron attachment, the incoming electron gets attached with the parent molecule forming a temporary negative ion (resonant state), which can either autodetach into the neutral parent molecule in the different vibrational and/or electronically excited state or dissociates into an anionic and neutral fragments – dissociative electron attachment (DEA).

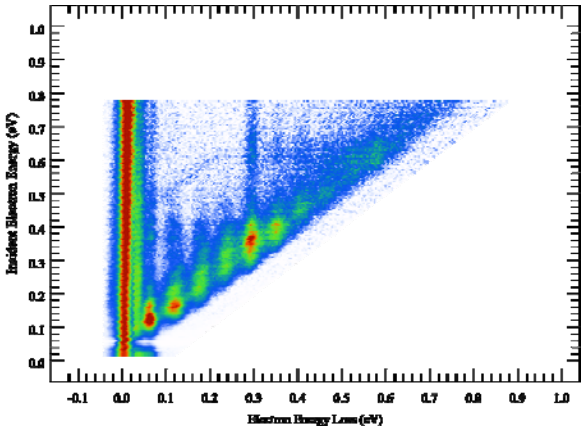

Figure 1. Two-dimensional electron energy loss spectrum of NCCN.

Two different experimental setups have been used to study the formation of resonances in NCCN – an electron energy loss spectrometer (EELS) with double hemispherical electron monochromator and analyzer and a dissociative electron attachment (DEA) spectrometer. The DEA setup, consisting a trochodial electron monochromator, has been modified here to incorporate a velocity map imaging (VMI) detector to be able to measure the kinetic energy and angular distribution of the produced anions along with the absolute DEA cross-section.

Figure 1 shows the two-dimensional energy loss spectra of the scattered electron recorded at 135^o with respect to the incoming electron beam. The 2D spectra is an elegant way to visualize the different vibrational excitations and resonances.

Figure 2 shows the time sliced velocity map images (VMI) of the CN^- ions produced via DEA in NCCN for two different electron energies. The absolute DEA cross-section, kinetic energy and angular distribution of the CN^- ions are measured here. In both vibrational excitation and DEA cross-section measurements two prominent resonances were observed around 5 and 7 eV. From the combined vibrational excitation and VMI measurements surprising effect related to the symmetry of the resonant state has been observed [3].

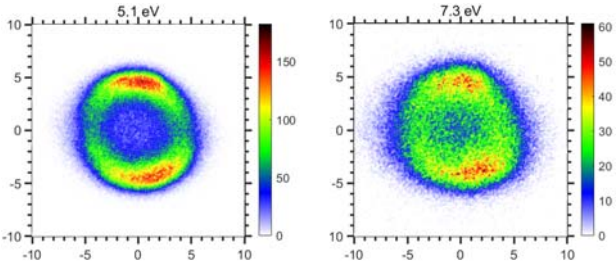

Figure 2. Velocity map images of CN^- ions produced due to DEA for two different incident electron energies.

References

[1] Kuhn A *et al* 1987 *Chem. Phys. Lett.* **135** 335

[2] Tronc M and Azria R 1982 *Chem. Phys. Lett.* **85** 345

[3] Nag P, Polášek M, Fedor J 2019, *Phys. Rev. A.* (submitted)

* E-mail: pamir.nag@jh-inst.cas.cz